

metal. This is cheaper, and enables the weight to be somewhat reduced. The bore is, of course, fixed by the diameter of the crank-shaft, and the length of the crank-pin is such as to limit the bearing pressure to 450 lb. per square inch. The width of the steel cap and of the palm of the rod may be about 0.7 of the length of the crank-pin, and the thickness of the cap may be equal to the diameter of the bolts, or such as to give a bending stress of 8000 to 9000 lb. per square inch for mild steel, and 6500 to 7000

P  
L

for cast steel, when the bending moment is taken as  $\frac{PL}{8}$ , P being the total

pressure on high-pressure piston, and L is the centres of the bolts. The stress on the bolts may be taken as from 5000 to 6000 lb. per square inch. Double nuts are used for all connecting-rod bolts with the addition of a split pin. The top has a projection fitting into a groove or circular recess in the foot of the connecting-rod to keep the whole structure in position and to resist to some extent the inertia forces caused by the swinging of the rod when working. Circumferential grooves are machined in the white metal to distribute the oil entering from the crank-pin. These grooves are off the centre in each half, in order to prevent a ridge being worn on the crank-pin.

**Eccentrics.** — The eccentric pulleys are often made of cast iron with the smaller part of steel, but some makers prefer to make the whole of malleable cast iron. The smaller part is usually provided with a tongue fitting into a corresponding recess in the other part, in order to locate the two parts.

When of steel it may have a thickness of  $\frac{d}{8} + J$ , where  $d$  is the diameter of the shaft.

The two parts of the eccentric are usually held together by cotter studs screwed into the smaller part. The diameter of these studs is made as large as can be got in, and the cotters may have a breadth equal to the diameter, and a thickness of a quarter of that amount.

The width of the eccentric may be about

half the length of the crank-pin. There is usually so much surface that the pressure is satisfactorily low. It should not exceed 100 lb. per square inch, when calculated on the basis used for the design of valve rods.

The eccentric straps, whether of cast or malleable-cast iron, should be lined with white metal.

The two studs for securing the foot of the eccentric rod may have the same diameter as the valve-rod bolts, and the bolts holding the two parts together may be a little thicker. The key for the eccentric may have a

breadth  $\frac{d}{6}$  in., where  $d$  in. is the diameter of the shaft. The thick-

-

+

6

ness may be half the breadth.

**Valve -rod and Eccentric -rod.** — The proportions of the valve gear are usually based upon the forces set up by the inertia of the heaviest valve in the engine, usually, of course, the valve of the low-pressure cylinder. As the ratio of the radius of the eccentric pulley to the length of the eccentric rod